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# **The Role of Consumers, Producers, and Regulatory Authorities in the Evolution of Green ICTs**

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## **Abstract**

The evolution of the information and communication technologies (ICTs) and the increase of the role given to environment in society have led to the widening of the green ICT concept. The way in which they can contribute to the improvement of life conditions, as related to the ecosystem, depends only on the interest and involvement of people, companies and state, directly or indirectly, influenced on their turn by the living standards, education and others. This paper aims to identify the way in which producers, consumers and regulatory authorities can contribute to the promotion and implementation of the green ICT concept, as well as its main influences on the environment and the society.

**Keywords:** green, ICT, e-waste, environment, non-renewable resources, innovation.

## **Introduction**

The sustainable development has been one of the important topics of research and practice during the last decades with undoubted complexity. The climate changes and the progressive decay of the environment have led to changes in the views on the management of economic and industrial processes, but what is more important is that they made the population be more interested in the environment issues. Even if the attitude is not unitary, worldwide, regarding the factual and potential measures to improve the negative effects of production and consumption on the environment, the initiatives widening in this field represent an important step for the future of mankind. The information and communication technologies are an important component of the economic and social life which favored the evolution during the last decades. Their intensive use was correlated to the effects on the environment, the initiatives being oriented towards the creation of hardware and software that would bring the least harm or even improve the unfavorable effects of massive industrialization. But generally speaking, innovation is pricey and risky and the trend towards green products is even more difficult due to the legal provisions and changes registered by the finished product. It also requires supplementary efforts to attract clients and induce the conviction that the offered devices respond to wishes.

Green products and consequently green ICTs involve changes in all the stages of the life cycle: design, production, distribution, usage and waste disposal in agreement to keeping a natural equilibrium. The opportunity to get involved in the green type category of activities is obvious for the environment, but it often seems that it is not as obvious for producers and consumers. The extremely rapid evolution in the ICT field has led to the shortening of the product life and increase in the speed for their replacement, which is more or less justified or rational while the resulted e-waste endangers the human life and the environment. If the developed countries succeed in protecting themselves to a certain extent by exporting the electronic waste to the under-developed countries, for the latter this is a real problem, deepened by the lack of education on environment protection and lack of proper legislation or poor enforcement. For example, a considerable volume of electric and electronic waste is exported to China, although it has been forbidden by law since 2000 and 2002 as mentioned Li et al. (2006). [8] According to United Nations Environment Programme (2010) approximately 80% out of the total of 40 million tons of e-waste generated yearly is exported to the developing countries. Also, in a report from Basel Action

Network, mentioned by MacLean (2010) the main importers are China, India, Pakistan, Vietnam, Philippines, Malaysia, Nigeria, Peru and Ghana. The responsibility for such practices is not undertaken by both parties, exporters and importers and finding solutions remains a problem of social awareness. The effects should spread from the developed countries, having the appropriate legal framework and could limit the production of polluting and energy consuming equipment and devices, towards the less developed ones, which undertake mainly the position of consumers but this is not necessarily a rule (we are thinking about the example of China and India who are top ranked on both parts of the market and have known a spectacular economic evolution during the last decades, due to the involvement in the ICTs production). Another important problem is the presence of dangerous metals, such as lead, mercury and cadmium, included in the ICT parts, on one hand, they are finite resources and on the other hand, they are found in e-waste, are not biodegradable and contribute to the increase of pollution. The CO<sub>2</sub> emissions represent another issue closely related to the production and use of ICT equipment and devices. According to some relatively recent studies made by the Centre for Energy-Efficient Telecommunications (CEET) and Bell Labs, published in ACS' journal Environmental Science & Technology (2013), they represent 2% (830 million tons) out of the total CO<sub>2</sub> emissions (a similar situation to the aircraft industry) and there is estimated that the number will have doubled by 2020. All these aspects are mentioned with the purpose of highlighting the unfavorable effects of using ICTs and the importance of stimulating innovations with green characteristics in this field.

If the previous mentions underlined the negative side of ICTs, we must make a note on the positive effects on the environment in order to achieve an objective image. At the present, the most significant accomplishments in this category can be seen in the development of software for an efficient management of the relationship with the environment having a well-defined form in the devices for the observation of the environment – terrestrial, oceanic, climatic and atmospheric – and data processing systems and technologies which, due to their ability to stock and process, give important information related to the environment changes and the possibility to give a forecast. There should not be neglected the speed of disseminating information on the condition and evolution of the environment which significantly contributes to the education of the consumers and producers, increase of knowledge on the current market and trends, an important aspect regardless of the position held to make the analysis, estimate the demand or offer. This information is an important source for the defining of the environment policies and establishing the regulations by the international organizations. All the concerns have led to the appearance of another important concept in the field, namely eco-informatics which aims to create software for the study of data and information on the ecological field, respectively the use, stocking and dissemination of information on the environment with all its components. In a final stage, the obtained results can be used in research and practical activities in order to estimate accurately the changes in the eco-system, generated by natural factors or appeared as a result of the human actions aiming to evaluate the general trends, under the action of the same factors.

### **What can the ICT producers do?**

The decisions made by the producers and their involvement in designing and developing green ICTs are influenced by a few aspects. Among the most significant ones, in our opinion, are the legal regulations, the competition, and the manager's ability to rightly lead the innovating potential of the company and to stimulate the employees to get involved in creating products, favorable to the environment. As regards the competition, it is unanimously considered to be the main triggering factor for technological innovation, of all kinds. The spectacular evolution of ICTs has made the big companies in the field to continuously search new facilities and new characteristics that would be included in the products in order to conquer the market, in the context of popularizing the environment, a protecting and long-lasting development thus following

the favorable characteristics of the eco-system. On the level of the green ICTs, the main efforts were made to reduce the energy consumption due to the receptive ability of the users to take in this characteristic and be aware of the immediate financial influences. The producers of equipment have a long way ahead for the increase of energetic efficiency, if we consider that the servers use roughly 60% of the maximum power when they are on, even if they do not process anything and when they work, they use approximately 15%-20% of the capacity, because over these values their response speed is much slower according to Foster (2011). Another used aspect, even if it does not aim directly to improve the effects on the environment is the diminishing in size and expansion in functions available on the products. Still, the efforts made in this direction should be mainly orientated to the big environmental issues namely pollution, energy, waste, renewable resources and the negative effects on the eco-system – in both stages of creation and usage, as well as in usage and disposal – and less for winning the market by incremental innovation of certain products which have a debatable use.

As regards the ability and availability of the management to encourage innovation in green ICTs, it is conditioned by the vision of the leaders and the market conditions, but also by organization's knowledge flows as Popescul mentioned (2012). The perception on the importance of the environment for the society and disseminating the opinions in the company could induce an attitude in favor of keeping the natural equilibrium and stimulate innovation. A very important role in this sense is held by the internal regulations regarding the environment which use the standards from the ISO 14000 group and are adopted by a great number of international companies and institutions with the purpose to rationally use the resources in order to protect the environment and improve the interaction with it and on a more pragmatic level, strictly financial, to accomplish supplementary potential incomes by improving the image of the company.

From the point of view of the producers, the strategy of fitting in the environment policy should be based on the 3R paradigm according to Computer Aid International (2010):

- *Reduce* the use of energy and raw materials as well as toxic materials used for the creation of ICTs by replacing them with bio-degradable ones;
- *Reuse* them by introducing again in the production cycles the equipment parts that had been out of use and extend their usage period in their initial or changed form;
- *Recycle* by different methods and in places that do not have a negative influence on the environment and the society.

The world organization Green Peace (2010, 2011) has made studies regarding the interest shown by the producers in the environment and they have made rankings for the period 2010-2012 depending on the pro-environment solutions they have identified and developed in the companies, the energy consumption and carbon emissions, but also on the policies regarding the environment. The obtained results show significant changes in the positions held by the companies, some disappeared and others showed up, as well as a growing number which prove an increase in the interest for the environment and the complexity of the relationships between companies related to this issue. On the other hand, the scores went down during the period 2010 – 2012 and that is why the organization highlighted a diminishing of the efforts.

Another study, made by PricewaterhouseCoopers (2012), which analyses the way in which the companies perceive the ICT value and the degree of familiarity inside the organization, shows that only 30% of the respondents coming from the companies considered on top (those who had reported an increase in incomes by at least 5% during the previous year) and 27% of the rest intended to invest in green IT. The study included 489 CEOs from USA companies with annual incomes greater than 500 million USD.

In our opinion, in cases where the initiative of the producers is not in agreement with the current environmental problems there is required a more aggressive attitude from the part of the regulatory authorities by setting limits for the products introduced on the market and being more encouraging by offering financial support to those who get involved in green innovations.

### **What can the consumers of ICT products do?**

As it is well-known, the preferences of the consumers are an important premise for the offer orientation. The studies made during the last period show an increase in the interest for the green products. Thus, according to the analyses made by Strategic Oxygen, GCI Group and Cohn & Wolfe (2008), the clients from the ICT field are interested in buying green products leaving aside the traditional ones, even under the conditions of higher prices. The study was addressed to more than 3500 people responsible for ICT product acquisition in companies from 11 countries: Japan, USA, India, Canada, Australia, Germany, Great Britain, Brazil, Mexico, France and Italy. The most relevant results of the research made by Strategic Oxygen, GCI Group and Cohn & Wolfe (2008) are the following:

- The degree of willingness to pay more for products with characteristics which do not influence the environment varies from one country to another and it depends on the estimation of the possibility to regain the investment. India is the leader for this component with 22.3%, followed by the USA (14.9%), Mexico (13.9%), Great Britain (12.9%), France (12.3%), Australia (11.9%), Brazil (8.4%), Canada (8%), Germany (7.9%), Japan (6.4%) and Italy (4.8%);
- The green products on top of the preferences are: portable computers (74%), office computers (72%), servers (64%), stocking units (64%), and network equipment (63%);
- The greenest companies from the point of view of the consumers are: Google, Apple, HP and Microsoft – mentioned by 21% of the respondents –, followed by IBM, Intel, Sony – by 20% – and Dell, by 19%. On the other end we find SAP, Alcatel-Lucent, Nortel and EMC;
- The main barriers in the purchase of green ICTs, identified by the persons responsible for their acquisition are the following: price (38%), internal disagreement/policies (25%), the impossibility to compensate costs by increasing efficiency (22%), inability of the producing companies to be persuasive as regards the investment regain (18%), lack of promotion for the green products from the producers (18%), unavailability on the market (16%), lack of impact on the environment (12%).

Another study, from 2011, which included 9000 respondents from Australia, Brazil, China, France, Germany, India, USA and Great Britain but which analyses the attitude of the consumers to the ecological products from all fields, made by Cohn & Wolfe, Landor Associates and Penn, Schoen & Berland (2011), highlights an increase in the interest. According to the given data, 60% of the participants are willing to buy from the companies which care for the environment. Also, the respondents from all the analyzed countries are willing to pay more for ecological products, especially those from developing countries. The main categories they intend to buy come from the technological and car industry. Another remarkable aspect, underlined by this study is that in all countries, except the USA, the consumers believe that the essential role in supporting the ecological innovation is played by the state, to the disadvantage of the private sector.

According to Unhelkar and Trivedi (2010), from the point of view of the companies, as consumers, the green ICTs initiatives should be included when planning the architecture of the company and should consider the following aspects:

- Re-factoring of existing business processes or the creation of new ones that reduce effort or other costs, e.g. consumables such as paper.
- Changes to ICT purchasing policies that promote the procurement of efficient technologies and standards.
- Re-factoring of existing application hosting arrangements which promotes a shared service model, e.g. virtualization which reduces server footprint within Data Centers.
- Buy instead of build application procurement processes which utilize software as a service models (SaaS) which obviates the need to implement technology in-house.
- Changes to internal staff and ICT policies that promote changes in behaviors such as utilizing stand-by PC modes and duplex printing (by default).

As it can be seen, the information given by the research done in the field related to the interest and concern of the population for environmental problems, as consumers, varies in a considerable degree, including on product categories. But, as Necula (2012) noted, every ICT consumer's preferences have a main contribution in scaling the dimension to which a software market evolves. The situation is similar for the hardware market. On the whole, the interest for environment protection is present and it is growing but it is negatively influenced by the poor promotion of the characteristics of the products/services or methods to obtain them with positive influences on the eco-system. At the same time, the lack of remarkable results in the green ICT field is hindering the companies in advertising the products (for example, the significant beneficial results in the reduction of energy consumption is over-advertised by all the producers in the ICT field – and not only – which shaped the opinion of the consumers related to the effects on the environment and turned their preferences towards certain products to the disadvantage of others).

### **What can the regulatory authorities do for the green ICT advertising?**

The stimulation and direct involvement in green ICTs represents a major concern for the international organizations, an aspect which is shown by the promoted policies as well as by the drafted and implemented regulations. The main propellant for the international organizations, in the context of the world collaboration encouraged more and more during the last decades is the economic and social growth in an equilibrated eco-system. According to the international statistics, published by International Environmental Agreements (2013) there are currently over 1750 agreements related to the environment. We mention only a few of them, considered the most important and highly connected to the ICT, in order to highlight the fact that the times when this concern first appeared are not far from the times of extraordinary development of ICT mentioned by Environment Division (2012) and The State Department (2001):

- From the Kyoto Protocol to the convention of the United Nations convention on the climatic changes (1997);
- The Basel Convention regarding the over-border transports of dangerous waste (1989);
- The Montreal Protocol regarding the substances which destroy the ozone layer (2001);
- The Vienna Convention regarding the protection of the ozone layer (1985);
- The UNO Convention regarding the climatic changes from Rio de Janeiro (1992);
- The Protocol regarding the heavy metals (1998).

At the level of each country, the level of involvement shown by the state is proved by the investments made in research and development, rather unitary worldwide. The way in which funds are allotted differs from one country to another. For example, in Denmark, Japan and the USA the policies and programs are administered on national level whereas in other countries, such as Great Britain, the organizational methods are independent according to Organisation for Economic Co-operation and Development (2009):

- In Denmark, the Action Plan for Green It was established by the Ministry of Science, Technology and Innovation;
- In Japan, the Green IT initiative was created by the Ministry of Economy with the involvement of the Ministry of National Affairs and Communication;
- In the USA, the Department of Energy got involved by the Green IT initiative and the Agency for Environmental Protection by ENERGY STAR, but the two agencies collaborate for the increase in the energetic efficiency.
- In Great Britain, the organization method is independent, each government department is responsible for the ecological ICT appliances, but the strategy and general action lines for the ICT field are settled on government level.
- The initiatives from each country are supported and completed by inter-government measures initiated by the European Committee in Europe and for some of the countries in Asia, North and South America by the Asia–Pacific Economic Cooperation Organization - APEC).

According to a ranking made by Organisation for Economic Co-operation and Development (2009), the policies and programs which manage the relationship with the environment can be split into three main categories: (1) those based on the reduction of direct effects of ICT on the environment, (2) those who are related to the use of ICT appliances in order to diminish the impact of the society on the environment and (3) those who combine the two categories of measures. The programs for the diminishing of the ICT direct or indirect effects on the environment, consider mostly the influences seen in the following trends according to United Nations Framework Convention on Climate Change (2009): less consumed energy (4% of the energy is used by the ICT field, the EU aims to reduce the consumption by 20% by 2020, Japan by 25%, the USA by 15%), global warming (the CO<sub>2</sub> emissions from ICT represent 2-2,5%; objectives: reduce CO<sub>2</sub> emissions by 2020 by 20-30% in EU in comparison to 1990, 20% in Japan in comparison to 1990, 30% in the USA in comparison to 2005, between 5% - 15% or 25% in Australia; the most optimistic and ambitious estimations come from Norway which aims to have cuts of 30-40% as compared to the volume from 1990), diminish water, air and soil pollution with direct effects on health and bio-diversity (coming especially from the ICT production – the programs concentrate mainly on eco-labeling and the waste coming from this field), reduce the consumption of non-renewable resources, other than energy (consumption of lead, copper and tin for the production of equipment which can be mainly regulated by recycling, revising and updating the ICT products), the issue of using soil in order to dispose of waste (the under-developed or the developing countries accept the deposit of such waste especially due to poor legislation), the use of water (ICT is considered one of the greatest six sectors which use water from the industry of semiconductors).

To encourage an eco-friendly attitude, including in ICT field, financial support programs and regulations should be more daring and severely applied. In many situations they are only declared, not applied, as we have seen in the case of e-waste.

Even if innovation does not appear firstly in the public sector and it supposes mainly the active involvement of the private sector which can be motivated in a variety of ways and on several premises, as long as they do not harm the official regulations, the state and the regulatory authorities have the responsibility to create an environment which encourages innovation and protects the innovators and on a second level, to finance innovation, an aspect of paramount importance for the environment protection technologies.

## Conclusion



Green ICT is a concern shown by the producers, consumers and regulatory authorities, but it has not reached the maximum potential yet. Even if the motivations are varied and often mainly financial (make savings, improve the image of the company, ensure continuity by diminishing the dependence on certain natural resources which are non-renewable and so on), the final result is important and the way in which they succeed in reducing the negative effects on the environment when over-using ICT. Mention must be made here of a critical issue, namely the relatively reduced degree of involvement of the state, especially in some countries/regions which combined with the lack of interest in the environment shown by the consumers leads to the aggravation of the ecological crisis and worsens the natural disequilibrium. This paper aimed to identify the main methods employed by the state, hardware and software producers as well as consumers, companies or individuals use and which influence the environment by using ICT products while being able to expand their green characteristics in both stages of creation and usage.

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